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Optimization of Extraction Process of Crude alginate from *Sargassum muticum* by Response Surface Methodology

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Introduction

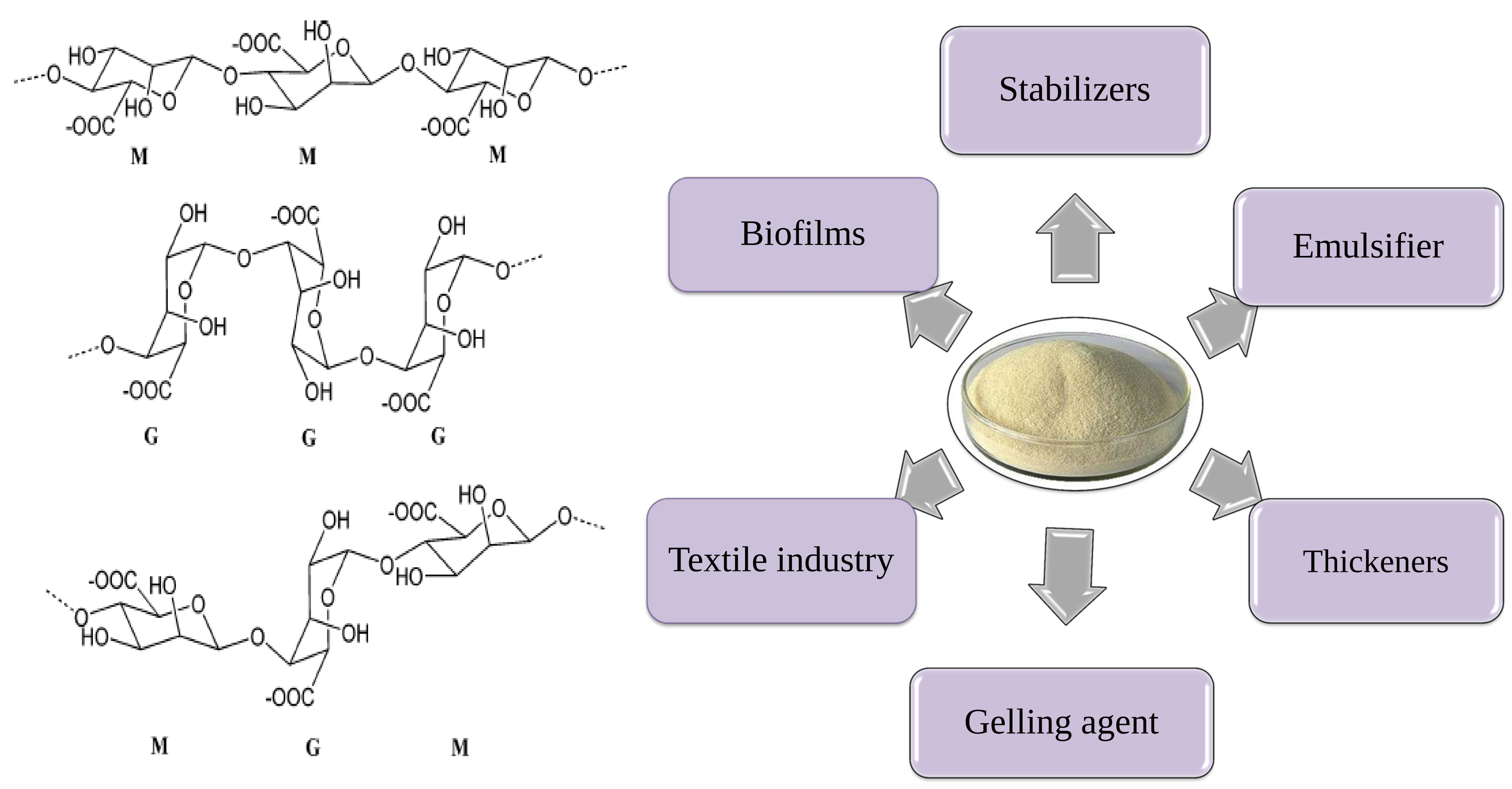

Fig. 1 Alginate structure (showing the combination of M and G blocks) and uses

- **Alginates are an anionic copolymer, comprised of β-D-Mannuronic acid (M-block) and (1→4)-linked α-L-Guluronic acid (G-block) units**
- **M and G blocks are arranged in non-regular block wise pattern of varying proportion of GG, MG and MM blocks**
- **Alginates are widely used in confectionary, and ice cream industry as emulsifiers, stabilizer and thickeners**

Objectives

- **Extraction of crude alginate from the brown macroalga *Sargasssum muticum***
- **Optimization of extraction parameters (temperature, alkali and ethanol percentage) using Response Surface Methodology**

Methodology

Dried algae soaked in 2% formaldehyde for 24 h at room temperature

↓

Washed with distilled water and 0.2 M HCl added and left for 24 h

↓

Washed with distilled water and extracted with (1-5%) sodium carbonate for 3 h in (60-100℃) temperature

↓

Soluble fraction collected by centrifugation (15,000 rpm, 15 min) and precipitated by ethanol (60-100%)

↓

Dried at 65˚C until constant weight reached

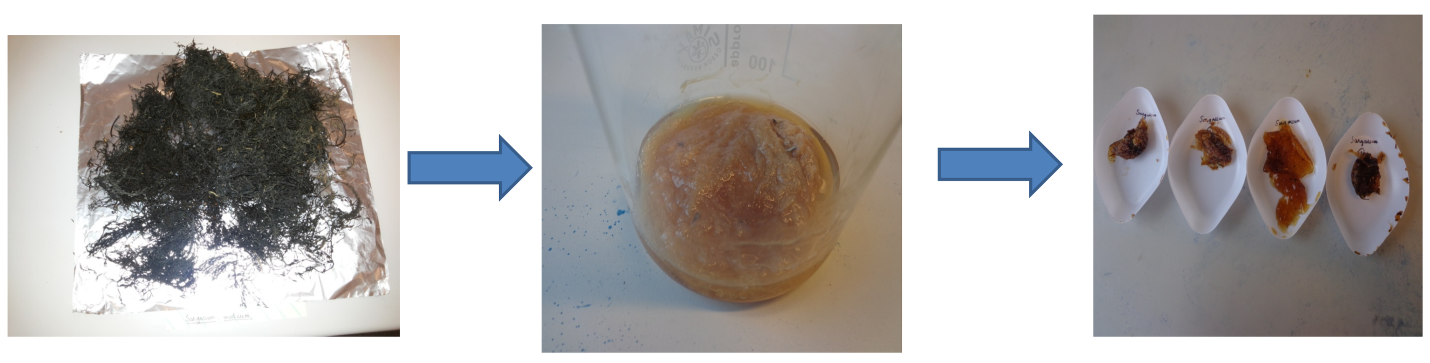

Fig 2 (a) dried algae (b) precipitated crude alginate (c) dried alginate

Methodolody according to proceedures of reference 1 and 2.

Table 1 Independent variables and their levels used in the response surface design

Independent variables	Levels of variables				
	-1.682	-1	0	+1	+ 1.682
Temperature (℃)	60	68	80	92	100
Alkali percentage (%)	1	1.8	3	4	5
Solvent percentage (%)	70	76	85	94	100

Results

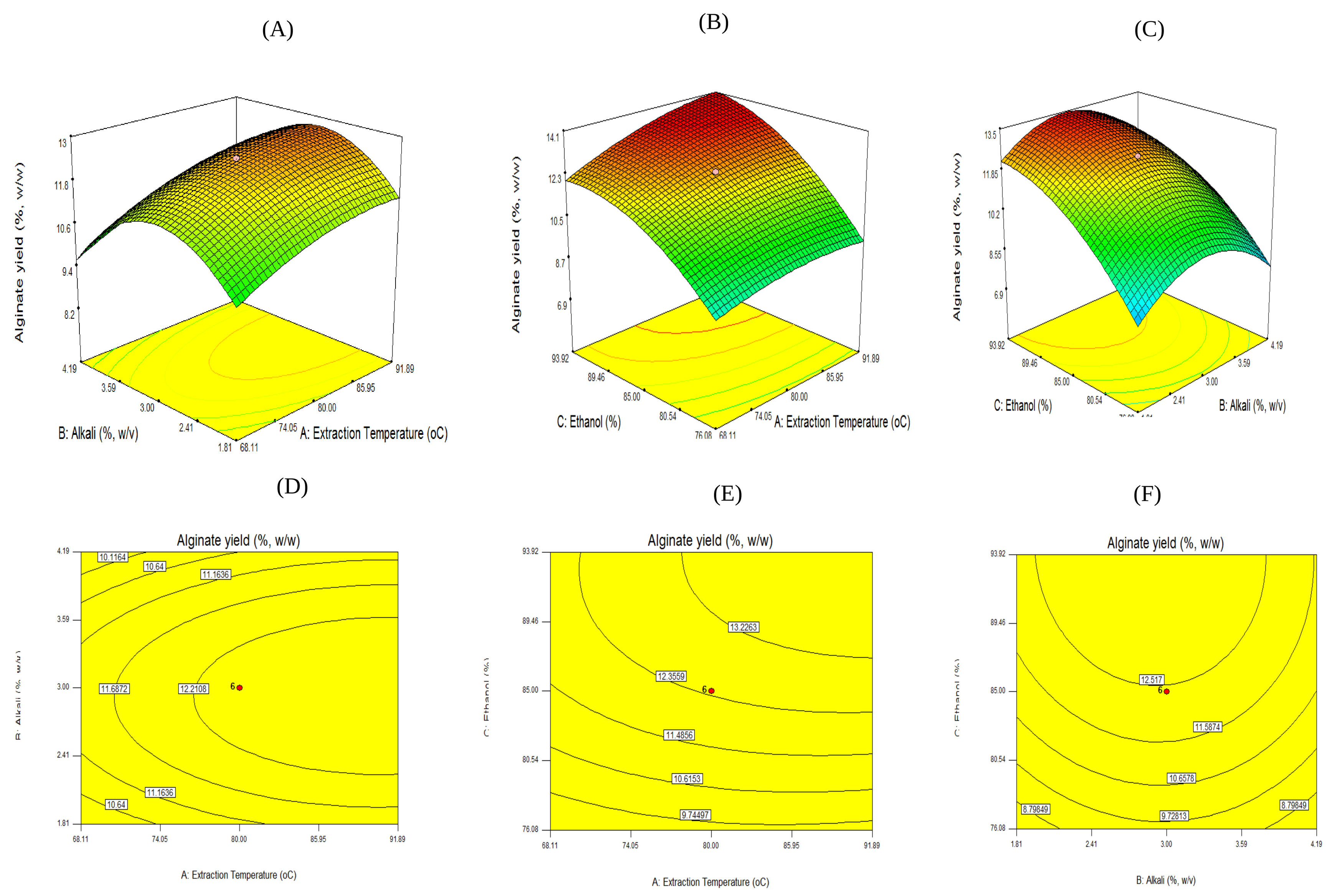

Fig .3 Response surface plots (A, B and C) and contour plots (D, E, F) showing the effect of extraction temperature, alkali percentage, solvent percentage on the extraction yield

Table 2 Analysis of variance for the fitted quadratic polynomial model of alginate extraction

Source	SS	DF	MS	F-value	Prob>F
Model	104.5	9.0	11.6	57.0	< 0.0001
Residual	2.0	10.0	0.2		
Lack of fit	2.0	5.0	0.4		
Pure error	0.0	5.0	0.0		
Core total	106.6	19.0			

R^2=0.9809 R^2_{adj}=0.9636 R^2_{pre}= 0.855

Model equation for alginate

*Alginate yield = 12.43 + 0.6 * A -0.21 * B +1.95* C + 0.031 * A * B +0.37 * A * -0.* B * C -0.36 * A2 -1.5 * B2 -0.9* C2*

Where, A = Temperature (˚C), B= Alkali percentage and C = Ethanol percentage

Alginate yield = 13.45% (w/w)

Major findings

- A method of alginate extraction from *Sargassum muticum* was optimized in respect to temperature, alkali and ethanol percentage
- **Optimum extraction yield of alginate was recorded at: 90℃, 3% alkali and 94% ethanol**
- The experimental yield (13.45%) was not significantly different to the theoretical value predicted (13.7%) which validated the entire methodology

Reference

1. Fenoradosoa, Taratra Andrée, et al. (2010) Extraction and characterization of an alginate from the brown seaweed Sargassum turbinarioides Grunow. *Journal of applied phycology* 22.2: 131-137

2. Rioux, L-E., S. L. Turgeon, and M. Beaulieu (2007) Characterization of polysaccharides extracted from brown seaweeds. *Carbohydrate polymers* 69.3: 530-537

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